WETLANDS ECOLOGY

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16. Abstract

The report period covers Phase I - Data Analysis Preparation and part of Phase II - Preliminary Data Analysis. The ERTS imagery analyzed provides approximately 2/3 coverage of the test site. Analysis was made using visual methods, density slicing and multispectral analysis. Preliminary conclusions reached are that most, if not all, of the investigation objectives can be met. Saline and near-saline wetlands can be delineated from ERTS-1 images as the wetland-upland boundaries and land-water interface are clearly defined. Major plant species or communities such as Spartina alterniflora (high and low vigor forms), Spartina patens/Distichlis spicata, and Juncus roemarianus can be descriminated and spoil disposal areas identified.

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PREFACE

The primary objective of this investigation (SR140 - Wetlands Ecology) is to test the use of ERTS-1 data in mapping, evaluating and future monitoring of wetlands and shallow water environments. This report covers Phase I - Data Analysis Preparation, and part of Phase II - Preliminary Data Analysis. ERTS imagery analyzed covers approximately 2/3 of the test site.

Analysis was made using visual methods, density slicing and multispectral analysis. Preliminary conclusions reached are that most, if not all, of investigation objectives can be met, saline and near-saline wetlands can be delineated, and plant communities and spoil disposal areas identified.

1. INTRODUCTION

This report summarizes the first 5 months (June - October, 1972) of work on ERTS-1 investigation SR140 - WETLANDS ECOLOGY (contract # NAS5-21752). The primary objective of this investigation is to test the use of ERTS-1 data in mapping, evaluating and future monitoring of wetlands and shallow water environments. This report includes Phase I - Data Analysis Preparation and part of Phase II - Preliminary Data Analysis. The first ERTS data were received on September 14, 1972, and as of October 31, 1972, one time coverage had been received over approximately 2/3 of the test site.

Following is a summary of work performed during the reporting period:

Phase I - Data Analysis Preparation

1. Initiation and partial completion of literature search.
2. Review of existing aircraft data over test site.
3. Field trips for collection of ground truth: species identification and distribution, etc.
4. Collection of spectral reflectance data to supplement previously collected data.
5. Training of graduate assistant both in the field and in the use of image analysis techniques.
6. Analysis of U-2 and RB-57 multiband photography of selected sites of test area using the USGS, MIAS and Datacolor machines.
7. Completion of analysis of impact of watershed development on wetlands in the Northeast River watershed using high altitude RB-57 color IR photography.

Phase II - Preliminary Data Analysis

1. Preliminary analysis of ERTS-1 imagery received since September 14, 1972.
2. Preliminary analysis of U-2 data received as requested in ERTS-1 aircraft support requirements.
3. Preliminary analysis of C130 photography over three selected sites in Chesapeake Bay (Mission 207). Scanner Data has been requested.
4. Multispectral analysis of selected imagery using Datacolor, MIAS, and I^2S systems
5. Participation in September 29 ERTS meeting at GSFC and in filming of NASA movie on ERTS applications.

2. PROGRESS REPORT

2.1 DATA ANALYSIS PREPARATION

2.1.1 Literature Search. The literature search for this investigation was begun in June 1972 and will continue throughout the duration of this investigation.

2.1.2 Aircraft Data. Aircraft missions over portions of the test site have been flown by NASA, USGS, USDA and private contractors. Table 1 (page 8) is a compilation from a number of data sources and includes NASA mission numbers where possible. This table is not intended to be a complete listing. Missions from which all or part of the data is available at The American University are indicated by an asterisk. Other data are available at USDA, NASA/Wallops Station, EROS Data Center in Sioux Falls or is the property of private contractors. W indicates a NASA/Wallops flight being utilized on freshwater wetlands studies.

2.1.3 Ground Truth Collection.

2.1.3.1 Field Trips. A number of field trips have been made to selected sites including test sites 168, 124, and 317 (target areas for NASA mission 207) and the coast of South Carolina, North Carolina, and Georgia from Ossabaw Island, Georgia to Cape Fear, N. C. Information collected during these trips includes identification and location of major wetland species and components (e.g., mudflats) and establishment of the nature of wetland boundaries -- upland and mean high water -- in different parts of the test site. At this time most effort is being concentrated in the saline and near-saline coastal wetlands because of end-of-season deterioration in tidal fresh-water and brackish wetlands by the time of receipt of ERTS data. Seasonal species composition of tidal fresh-water wetlands in the upper Chesapeake Estuary is being examined under a separate cooperative agreement between USGS, the State of Maryland and NASA/Wallops. The results of this study may be most useful to this ERTS project during the 1973 growing season.

2.1.3.2 Spectral Reflectance. The collection of spectral reflectance data from major wetland plant species and communities has been underway since 1969. Data collection during the period June - September 1972 was designed to round out

pre-existing data. Processing and analyzing these data will continue during the next few months. At the present date, seasonal or one-time spectral reflectance data have been collected for 28 species from saline, brackish and fresh water environments. In addition, the reflectance characteristics of a number of wetland components -- mud, water, sand, etc. -- are a part of the "signature" bank.

2.1.4 Personnel Training. The graduate assistant has participated in extensive field work and has made limited use of multispectral analysis (MIAS) and density slicing (Datacolor). An abstract of work proposed under the present ERTS contract in fulfillment of the thesis requirements for The American University Biology Department follows:

Satellite Imagery and Vegetation Mapping of Saline Wetlands in Chesapeake Bay

High altitude photography has been used successfully to identify and delineate saline wetland species. Initial analysis of ERTS-1 data indicates an ability to detect these wetland species on satellite imagery.

The objective of this proposal is to identify and map those saline plant species and communities recognizable from satellite imagery. Vegetation maps produced from both high and low altitude photography will be compared with maps made from satellite imagery. Multispectral analysis (MIAS, I^{2}S), and single band density slicing (Datacolor) will be utilized to aid interpretation.

A large saline marsh located at the Nanticoke River entrance to the Chesapeake Bay has been chosen as the test site for this investigation. This marsh contains several tree islands and large stands of needlerush (Juncus roemerianus), salt meadow cordgrass (Spartina patens) and smooth cordgrass (Spartina alterniflora), of both high and low vigor forms. There are small monospecific stands of giant cordgrass (Spartina cynosuroides), saltgrass (Distichlis spicata), and threesquare (Scirpus sp.) as well as mixed plant communities. Mud flats and tidal pools of varying dimension along with the typical meandering streams characterize this tidal marsh.

2.1.5 Multispectral Analysis and Density Slicing. U-2 and RB-57 multiband photography of selected test sites was analyzed using the U.S. Geological Survey's MIAS and Datacolor. This analysis was undertaken to provide experience in using the equipment and to provide data for comparison with ERTS. The I^2S system was also utilized for this preliminary work.

The analysis was hampered by the lack of 3 usable bands of data (green, red, and IR) from any one RB-57 mission over many of our primary test sites and by vignetting on most RB-57 and U-2 frames. U-2 photography flown over South Carolina and North Carolina in August 1972 proved extremely difficult to register accurately and had numerous processing flaws which complicate analysis. Because most of the information in the saline wetlands lies in the most dense portion of the image or film positive, the light input required for analysis of wetland detail completely obscures any detail in upland areas and in fresh to moderately brackish wetlands. This problem is further discussed in section 2.2.1.

2.1.6 Northeast River Study Results. In the spring of 1972, a study was initiated to determine the source of sediment in the upper Northeast River, Maryland. The sediment was clearly visible on both color and color IR aerial photography from missions 166 (May 1971) and 144 (September 1970).

Two major sources were located as a result of considerable field work and analysis of color photography and are as follows:

(a) Run-off from agricultural fields into both the Big and Little Northeast Creeks, major tributaries of the Northeast River;
(b) Run-off from sand and gravel operations being conducted in the Little Northeast Creek and some other minor tributaries.

This removal of natural ground cover adjacent to the river and its tributaries appears to be a contributing factor to the large sediment content of the river water following moderately heavy and heavy rains.

Algal blooms were also visible on the photography and it was subsequently discovered that raw sewage overflow enters upper Northeast River via a small unnamed tributary.

The aerial photographs were also used to estimate remaining tree and shrub cover on tributaries and to establish land use in the area. The photography was not useful for actual location of sediment sources because ground truth was not collected during the overflight and the high altitude made pinpointing sources of sediment from smaller tributaries difficult to establish.

2.2 PRELIMINARY DATA ANALYSIS

2.2.1 ERTS-1 Imagery -- Visual Analysis. Visual analysis with light table and suitable magnifying equipment and with the Itek viewer indicates:

(a) The quality of the imagery is excellent and resolution surpasses earlier expectations.
(b) Considerable magnification is possible without loss of sharpness or detail. An effort to determine the best magnification for gross analysis of species composition is underway.
(c) The wetland/dryland interface is clearly defined in the IR bands. Separation of water and wetlands is good except in areas interlaced with numerous small tributaries.
(d) In areas where relatively broad transition zones between wetland and dryland are found (northern portions of test site), it appears that these zones can be detected on the imagery and may be used to judge successional trends.

Some difficulties were encountered in this part of the analysis. The B/W 9x9 and 70 mm MSS band 7 image of the Chesapeake Bay (Washington, D.C.) # 1062-15190-7 appeared to be somewhat out of focus in the area around the Rappahanock River marshes although the detail was sharp in the Nanticoke area. As mentioned in section 2.1.5, most information in saline and near-saline wetlands is contained in the denser portions of the film positive and additional processing may be required to stretch the contrast range and bring out details.

2.2.2 Multispectral Analysis and Density Slicing. RBV and MSS bands have been analyzed singly and collectively using the Geological Survey's MIAS and Datacolor and the I^2S systems. Color composites (NASA) have been examined where available. The following preliminary results have

been obtained:

(a) MSS bands 6 and 7 are very similar and one or the other may be used for density analysis or additive color enhancement.
(b) Color enhancement by density analysis of single bands will be useful in delineating wetlands; e.g., tree islands and upland boundaries are clearly visible in MSS band 7. Both red and green bands (MSS 5 and 4) show little detail within the wetland.
(c) Tonal structure in wetlands is good when color additive viewing or color composites are utilized. This tonal structure reflects species differences such as Spartina alterniflora (salt marsh cordgrass), Spartina patens (salt meadow cordgrass)/Distichlis spicata (spike grass), and Juncus roemerianus (needlerush).

The following ERTS-1 frames were used for the analysis reported in this report:

1079 - 15133	1000 - 15192	1001 - 15264
1070 - 15081	1024 - 15000	1010 - 15322
1062 - 15190	1000 - 15203	1046 - 15322

Preparation of the Data Analysis Plan has begun and further discussion of interpretive results will be included in this plan.

2.2.3 Mission 207. Preliminary analysis of C 130 photography over the Chesapeake Bay test site (168, 124, 317) has been completed and scanner data has been requested.

2.2.4 Participation in Meetings. Investigators on this proposal presented a 5-minute talk at the September 29, 1972, ERTS meeting at GSFC and attended the University of Michigan Symposium on Remote Sensing of the Environment, October 2 - 6, 1972. Both the PI and Co-Investigator participated in filming of a NASA movie on ERTS applications.

2.3 NEW TECHNOLOGY

No data available for this section.

2.4 PROGRAM FOR NEXT REPORTING INTERVAL

The tentative outline for the next reporting interval is as follows:

(a) Field trips to Chesapeake Bay, Nanticoke River site;
(b) Continue use of data enhancement equipment including density slicing with Datacolor and I^{2}S and multispectral analysis with MIAS;
(c) Enlargement of selected areas in the Chesapeake Bay and South Carolina to determine the point at which spectral resolution and image scale are optimum;
(d) Develop format by which wetlands in the two principal test sites will be mapped;
(e) Continue analysis of ERTS-1 imagery as it is received. Data has not been requested for most of the winter season, but complete available coverage from the summer and fall has not been received.

2.5 CONCLUSIONS

Based on less than two months of actual ERTS-1 image analysis, it is the opinion of the investigators that most, if not all, of the objectives of the overall proposal can be accomplished. Delineation of saline and near-saline wetlands including land-water interface and wetland-upland boundary is definitely possible. Large plant communities and such features as spoil piles and tree islands within the wetlands can be identified and delimited. Interpretation of shallow water areas has not been attempted to date.

Problems of delay in receipt of data and degradation in aircraft photography still need to be solved. Questions of appropriate magnification and processing of original imagery also remain to be answered.

2.6 RECOMMENDATIONS FOR FUTURE ACTIONS

The following recommendations would facilitate data analysis and reporting:

(a) Receipt of data within 2 weeks after ERTS overflight. For example, there was good data available over our southern test site in July. It was September 14 before the first data arrived at The American University. Before a field trip could be arranged, some of the wetland species had undergone seasonal decline and could not be identified.
(b) Improvement of underflight data from U-2. Processing flaws have been common on U-2 data which has severely limited its use in data enhancement machines.

Table 1 - AIRCRAFT DATA AND SOURCES FOR SR140 - WETLANDS ECOLOGY

Mission # (if known)	Date	Site	Source
* 74	6/20/68	CARETS	NASA
* 79	9/12/68	"	"
* 103	9/15/69	"	"
* 104	9/15/69	"	"
* 132	7/7/70	"	"
* 144	9/23/70	"	"
* 166	5/18/71	"	"
* 207	7/15/72	"	"
W90	10/15/71	"	NASA/Wallops
W119	4/18/72	"	"
W125	4/28/72	"	"
W131	6/3/72	"	"
W147	7/10/72	"	"
W162	8/25/72	"	"
W167	9/8/72	"	"
W175	10/17/72	"	"
*	9/29/69	"	RADC
*	8/23/69	"	RADC
* 53	7/10/67	North Carolina	NASA
107	1/72	" "	NASA
120	4/19/72	" "	NASA/Wallops
--	4/7/70	South Carolina	USGS
Assorted Missions	--	CARETS & North Carolina	NASA/Wallops
--	--	South Carolina	LKB
B/W	--	CARETS	USDA
	1971, 1972	Maryland	Dept. of Natural Resources/State of Maryland